



Biochar: New Wedge to Sustainable Emission Reductions

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VISIT...

LANZAROTE
Caliente.COM

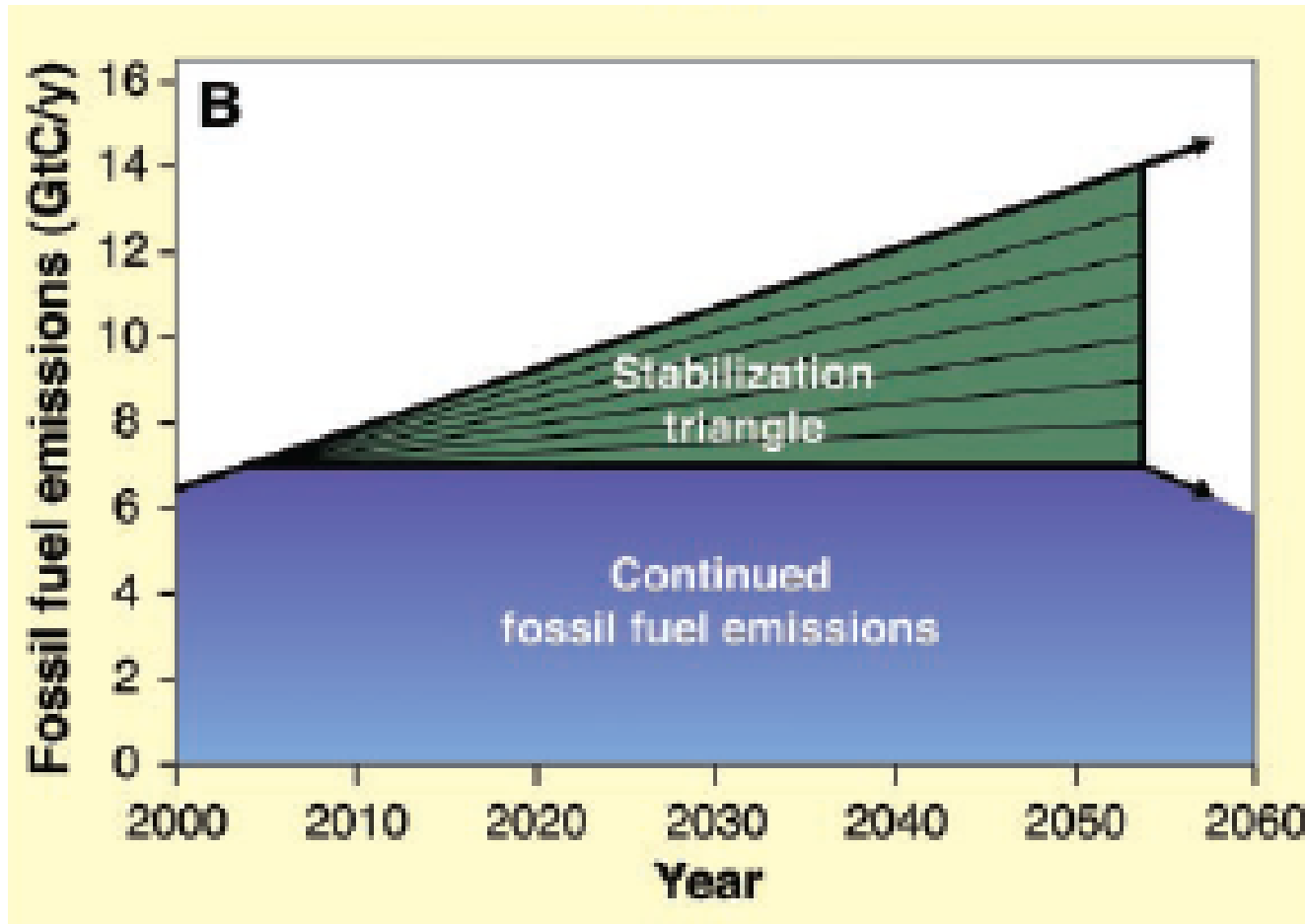


First and foremost:

**Reductions in GHG
emissions from Energy
generation**

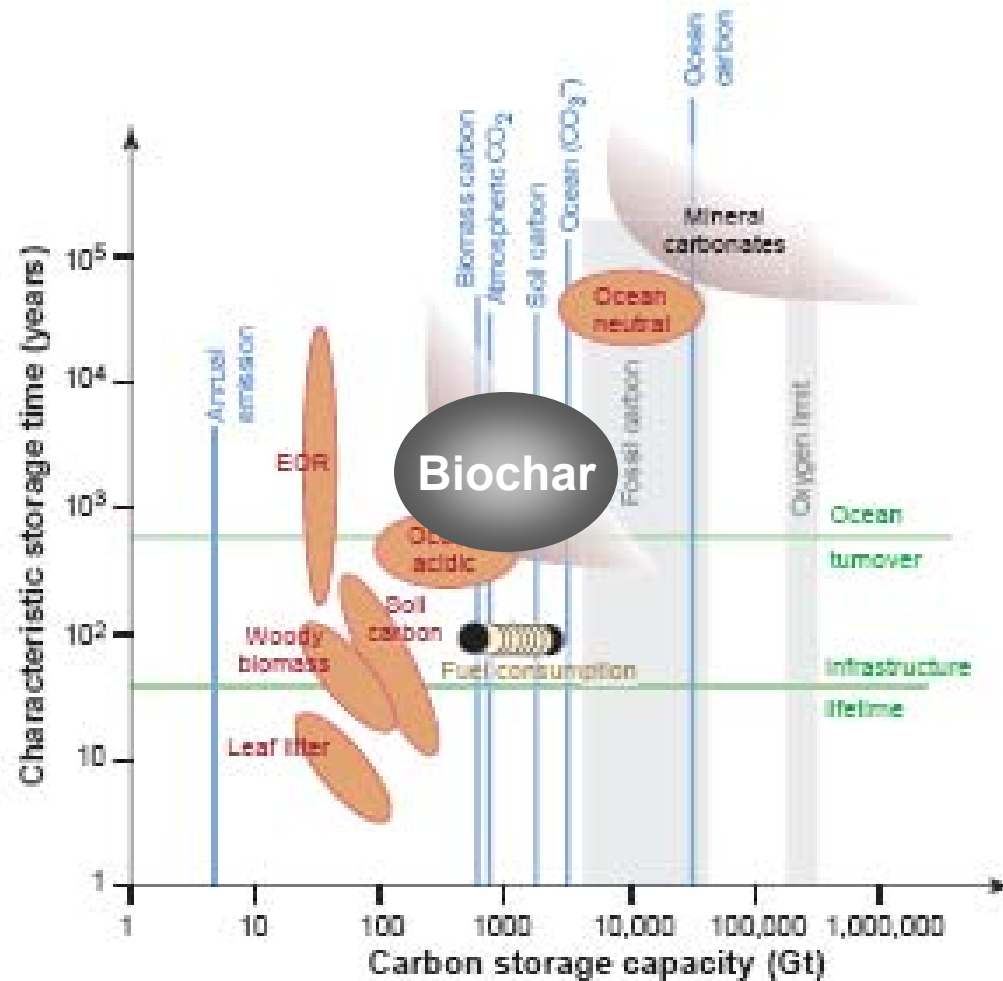


Biochar – a possible wedge



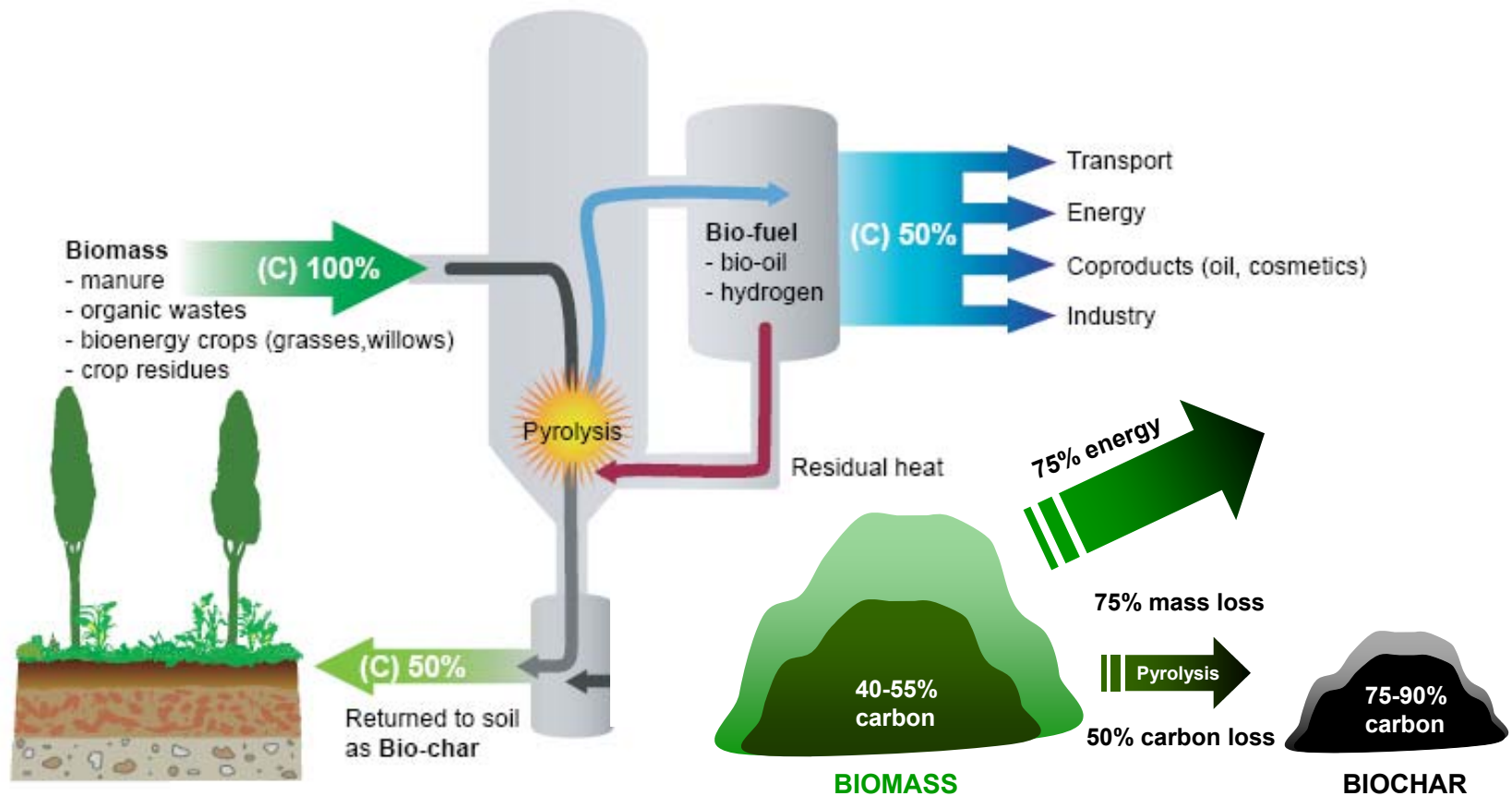


Carbon **withdrawal** from the atmosphere



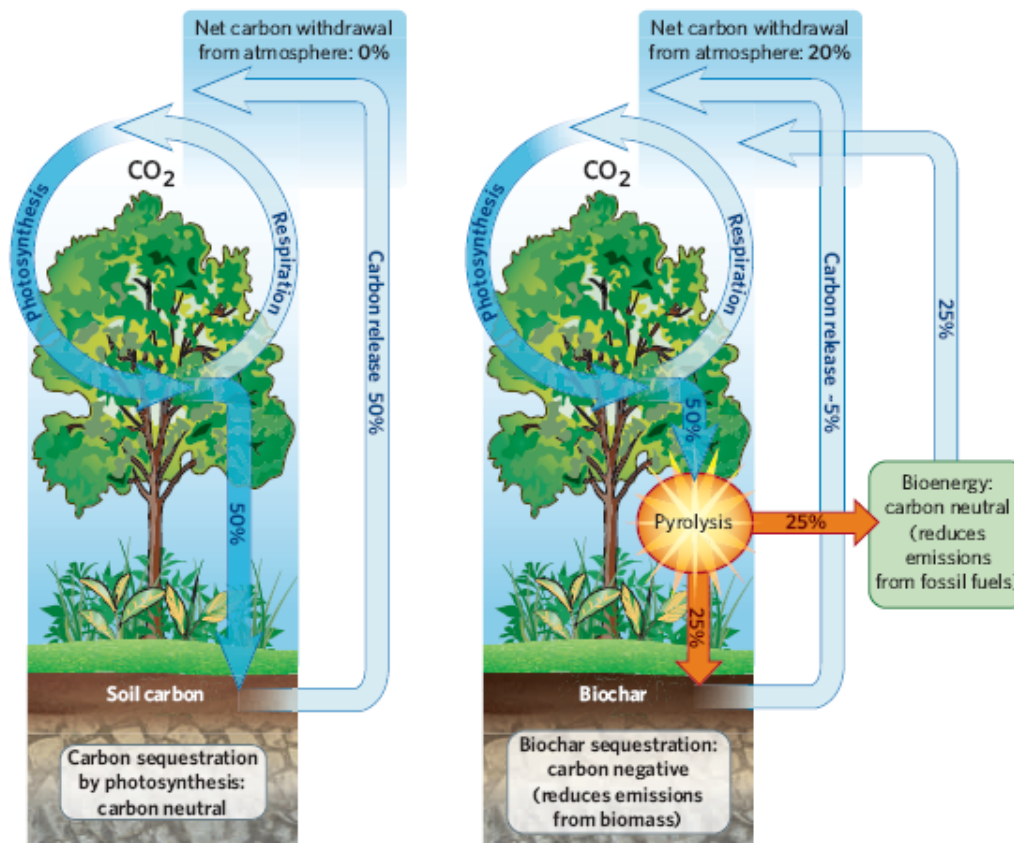


Biochar = carbon-rich residue of heating biomass without oxygen



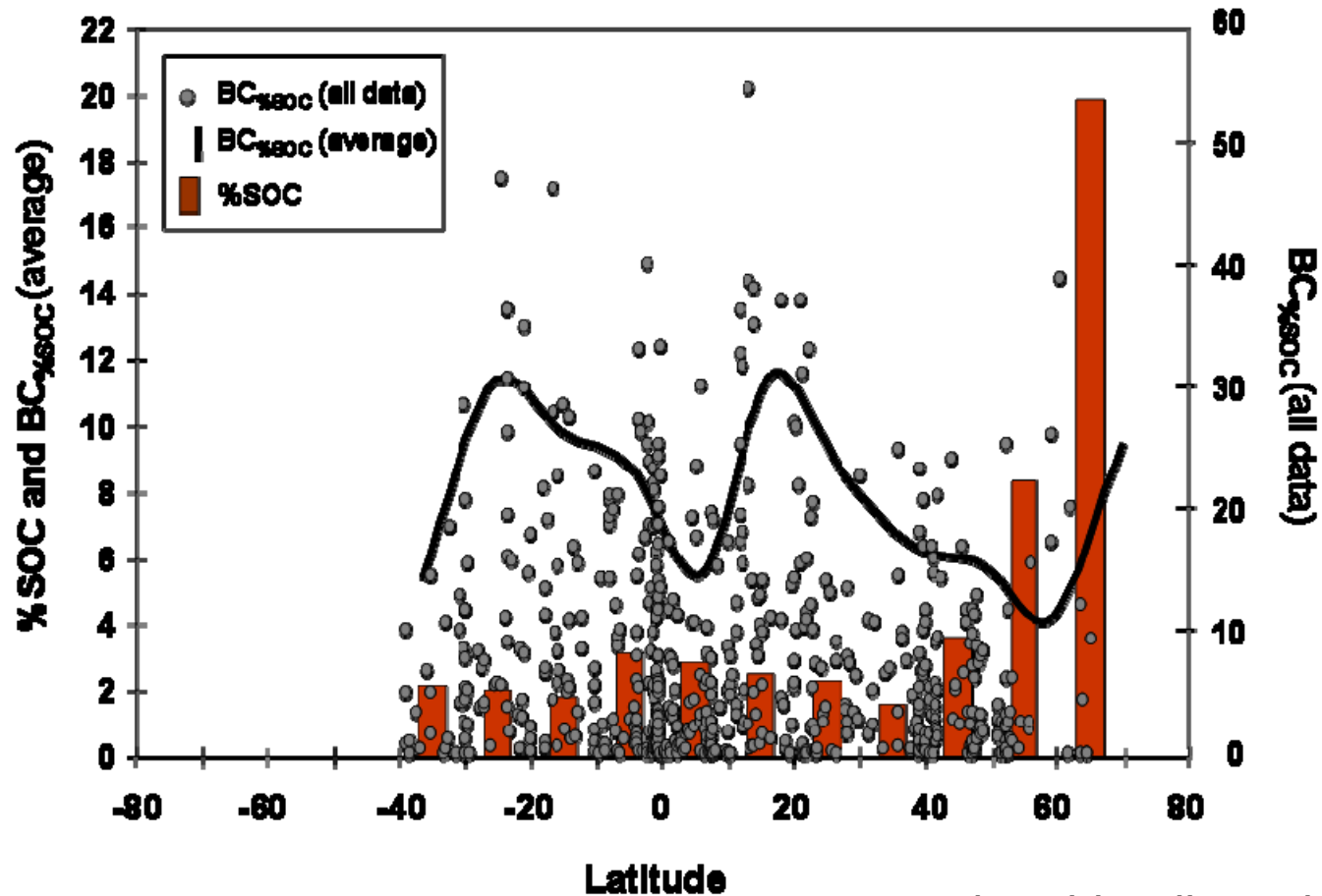


Biochar = slowing down the rapid biological return of CO₂





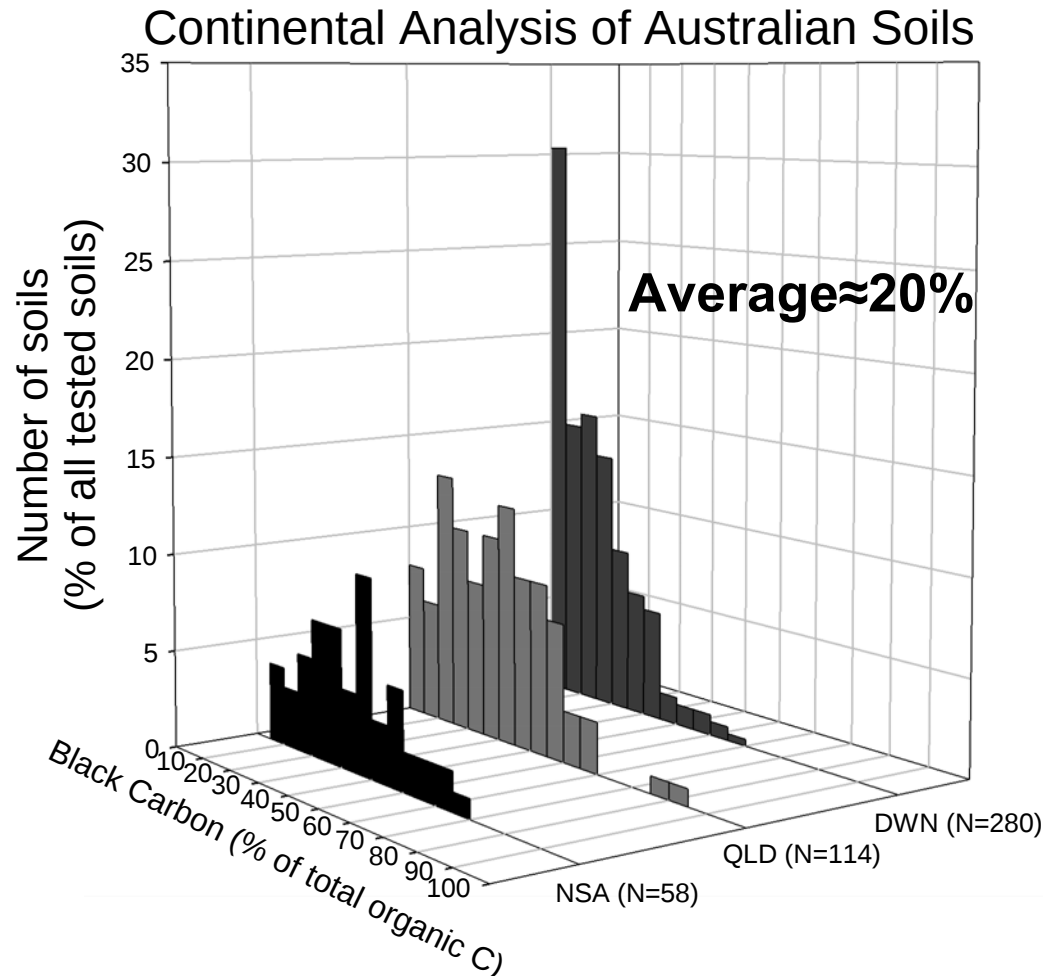
Biochar = management of an **Existing Carbon Sink**



(World Soils Archive ISRIC)



Biochar = management of an **Existing Carbon Sink**



34Gt SOC (0-1m)

(Grace et al., 2006,
Carbon Balance and Management 1,14)

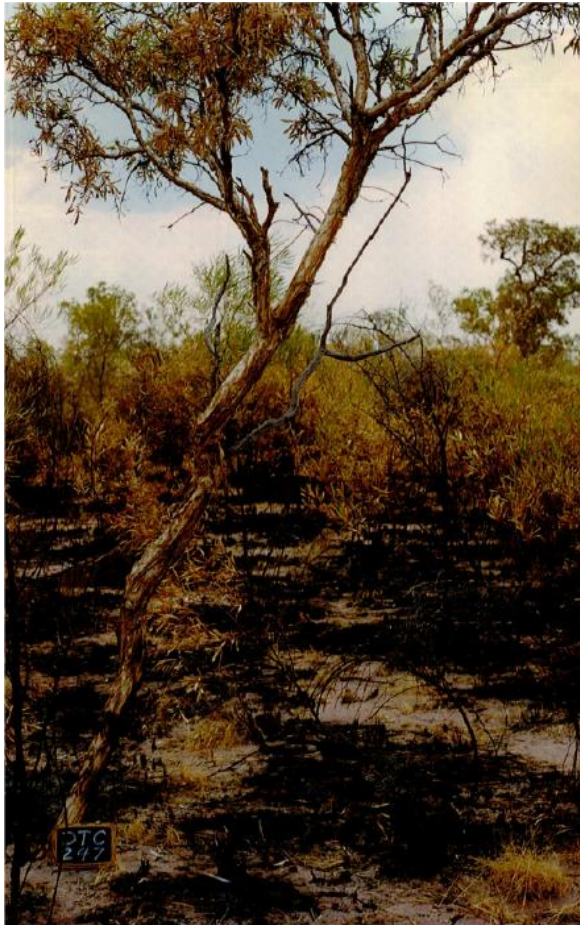
0.3Gt=1% point

0.1Gt CE /yr fossil fuel

(Department of Climate Care, 2008)



Lehmann et al, 2008, *Nature Geoscience* 1, 832 - 835



Biochar Storage Time

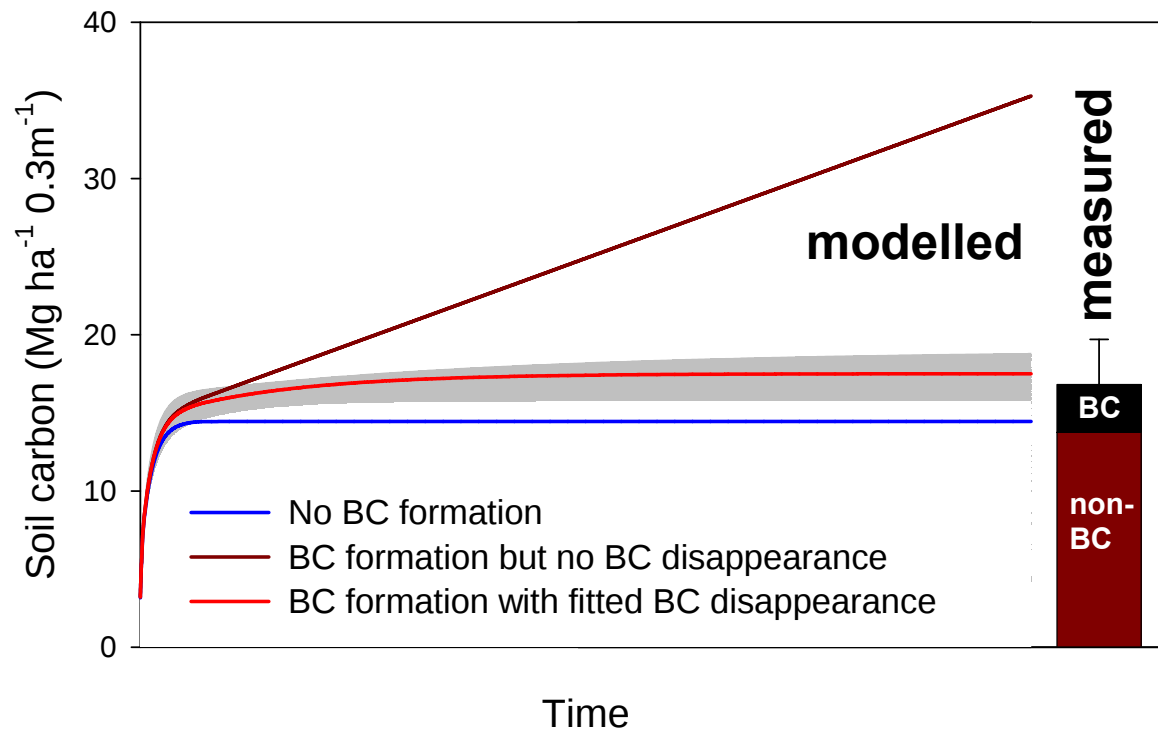
Inceptisols (Northern Territory, Australia)

13 and 15 profiles

27°C MAT, 887 mm MAP

Under varying assumptions of burning severity and BC formation

Model run to equilibrium (for BC MRT to 1m)





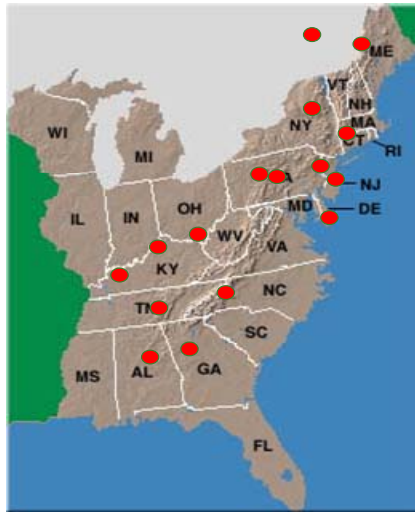
Biochar Storage Time

Mean residence time (years)			
Black C formation of (% of C in burned vegetation)			
	1	2.5	4
Vegetation burnt (% of total vegetation)	Light-textured Inceptisols at Katherine (MAP ¹ 887 mm; MAT ² 27°C; clay 13%)		
60	4292	1715	1074
70	3674	1471	921
80	3212	<u>1300</u>	806
90	2856	1145	718
	Heavy-textured Inceptisols at Daly Waters (MAP 738 mm; MAT 27°C; clay 21%)		
60	9259	3506	2163
70	7704	2984	1855
80	6631	<u>2603</u>	1623
90	5841	2310	1444

Lehmann et al, 2008, *Nature Geoscience* 1, 832 - 835



Biochar Storage Time

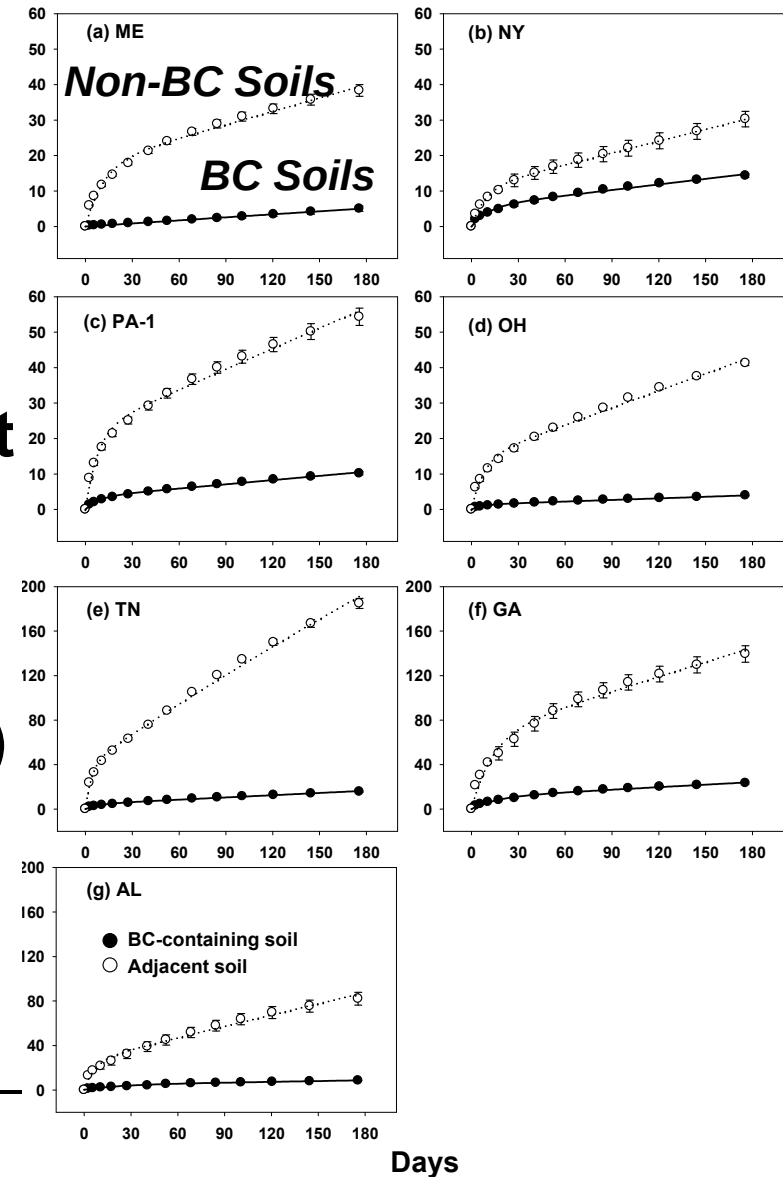


Biochar from storage areas
for historical pig iron
production
(130 years old)



**MRT of 1335 yrs
at 10°C MAT**

**Stability of
remaining did not
change across
the climate
gradient.
(130 years)**



Cheng, Lehmann et al., 2008,
Journal of Geophysical Research, 113, G02027



Biochar Storage Time

**Mean residence time in soil:
Upper hundreds to a few thousand years**

(regionally different dependent on temperature and moisture)

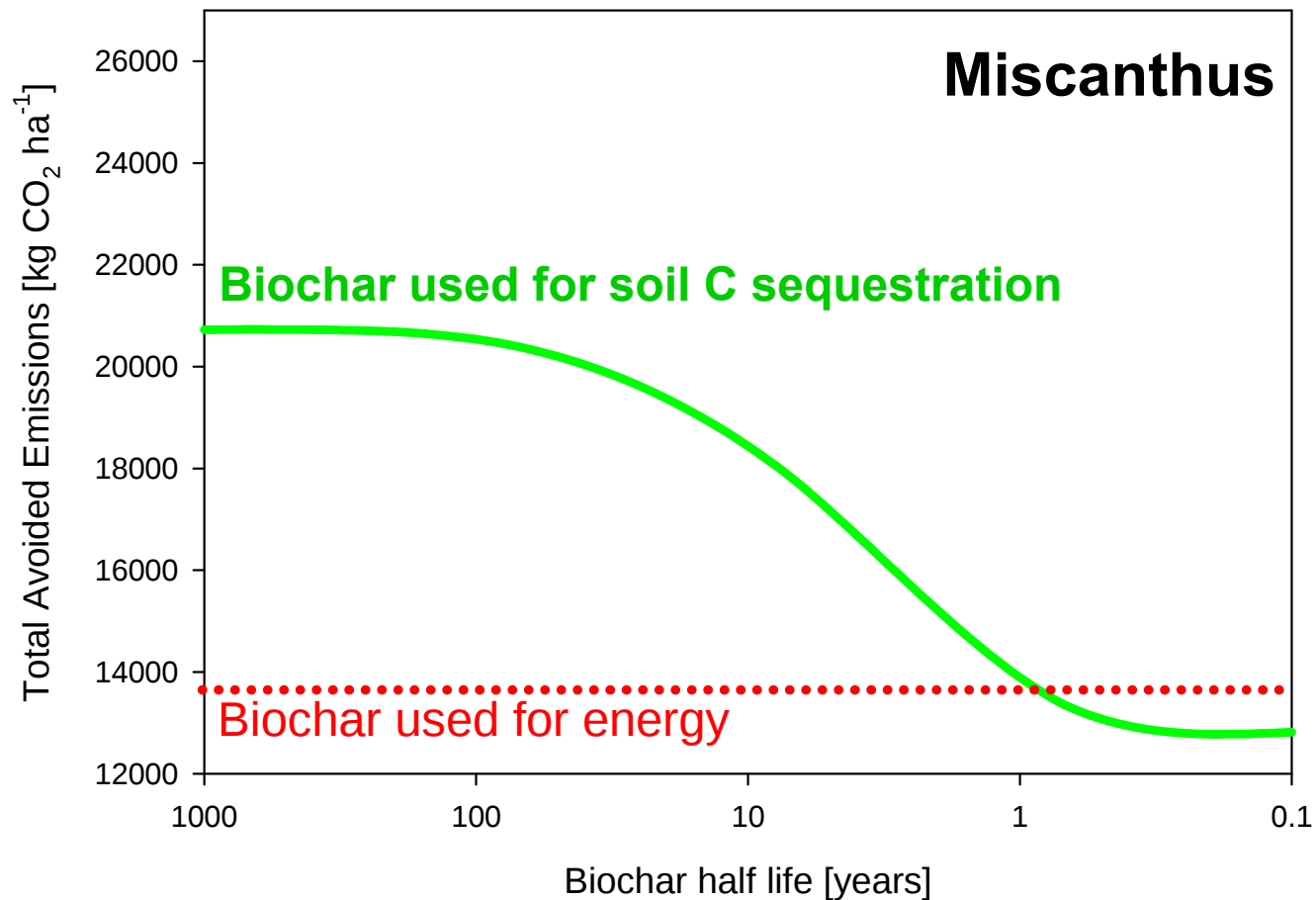
Lehmann et al, 2008, *Nature Geoscience* 1, 832 - 835

Liang et al, 2008, *Geochimica et Cosmochimica Acta* 72, 6096-6078

Cheng et al., 2008, *Journal of Geophysical Research*, 113, G02027

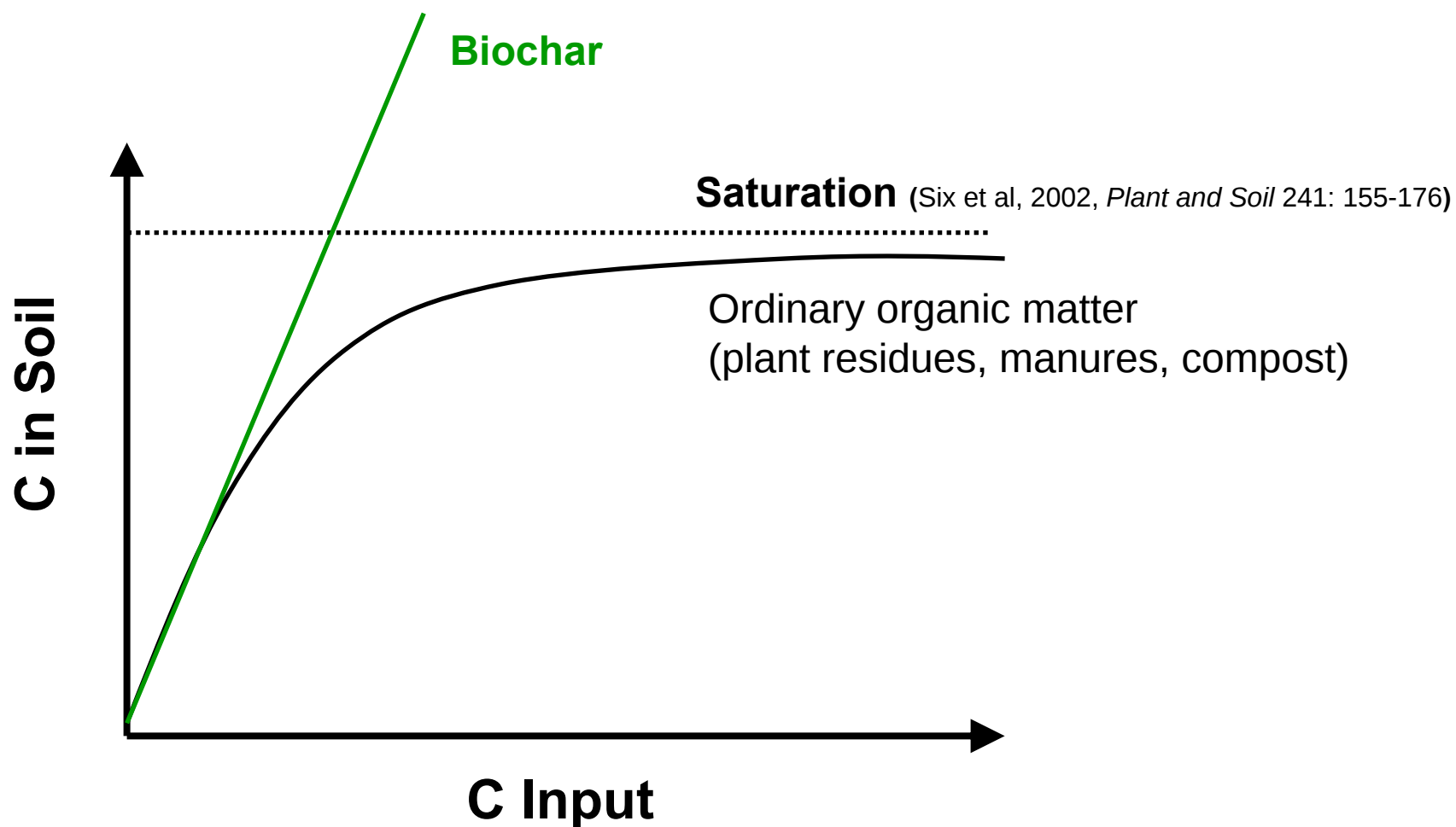


Biochar How stable does it need to be?





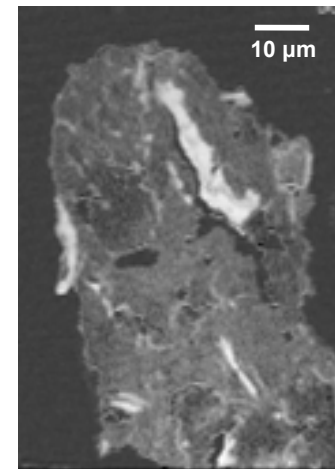
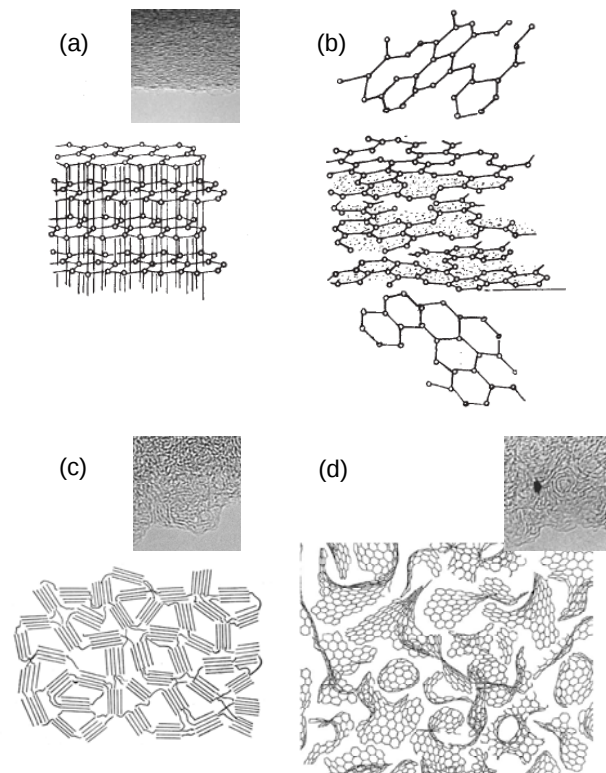
Biochar Storage Capacity





Biochar Storage Capacity

Chemical stability + particulate nature



Total Carbon

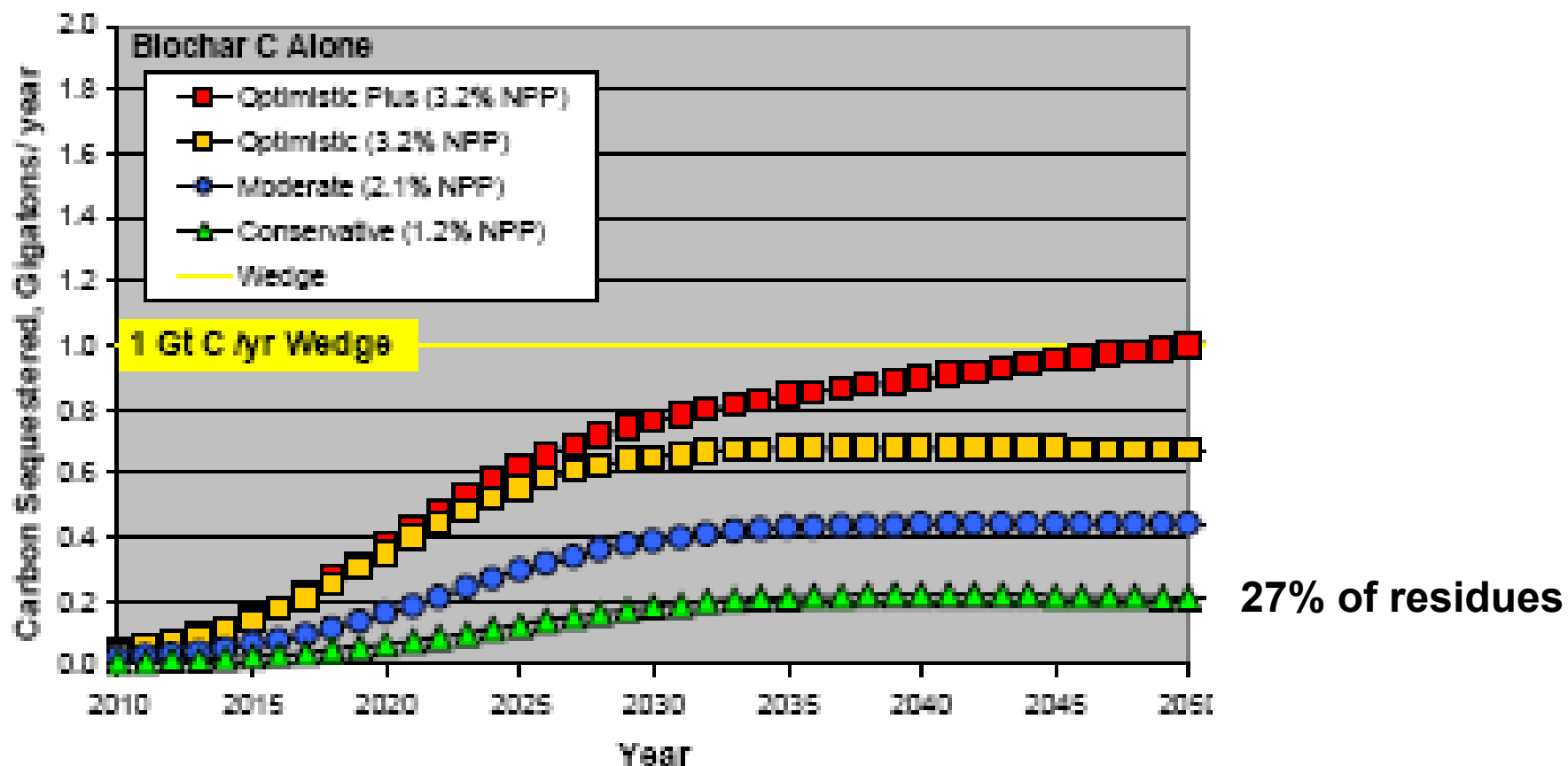


Biochar



Biochar Storage Capacity

Four sustainable scenarios using biochar technology



(see separate handout)

Amonette et al, unpubl.



Biochar Soil Improver



Value at sequestration



500-8000 years

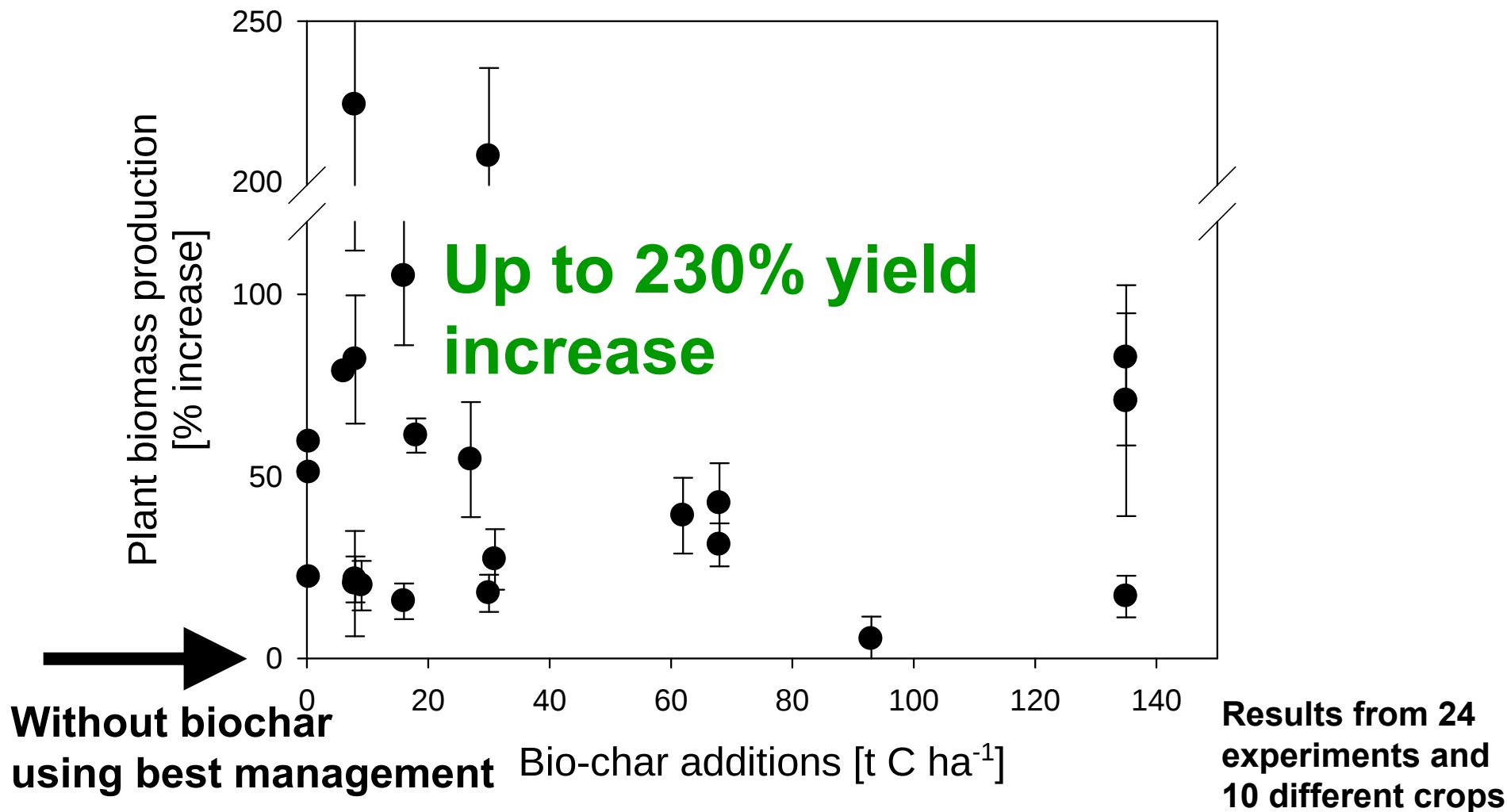
'normal' soil

"Terra Preta"

(Central Amazon, Brazil)



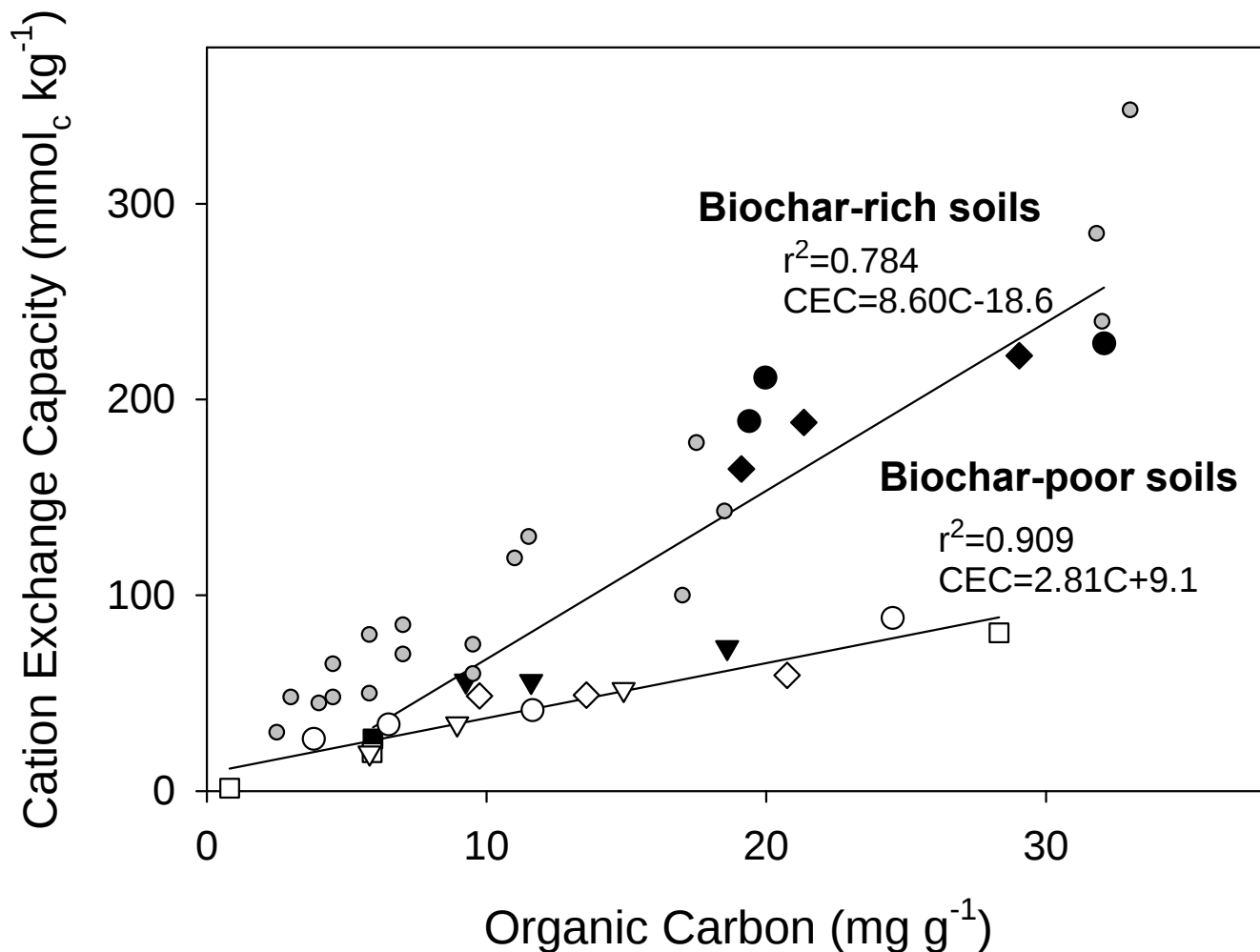
Biochar Soil Improver



Lehmann and Rondon, 2006, *Bio-char Soil Management on Highly Weathered Soils in the Humid Tropics*. Francis and Taylor, FL, pp. 517-530

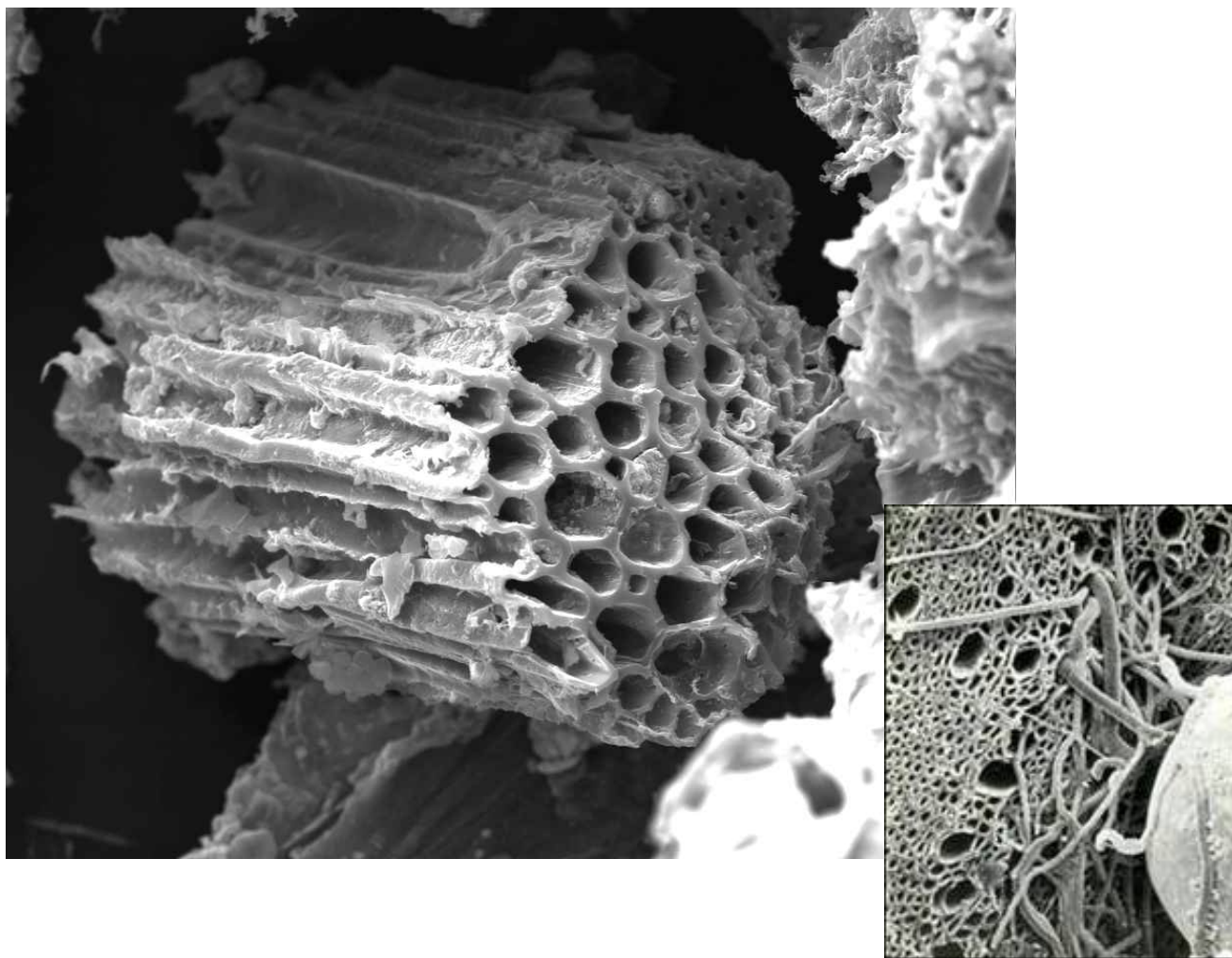


Biochar Soil Improver





Biochar Soil Improver



Ogawa



Other **Biochar** Sustainability Benefits

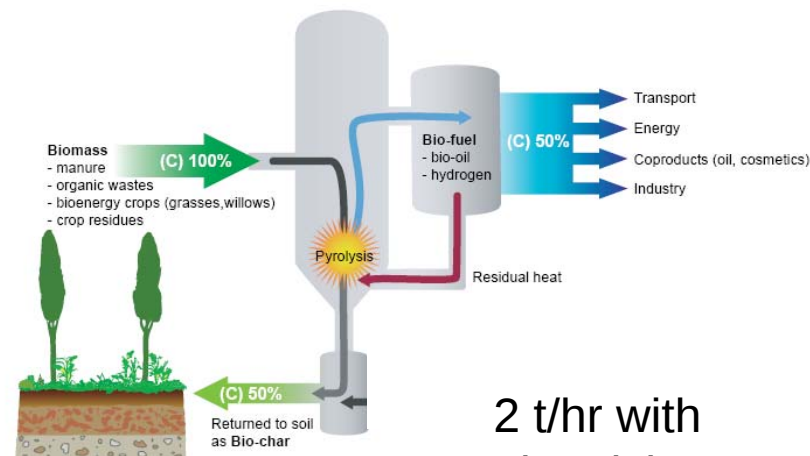
**Lower indoor pollution=lower respiratory
+ eye infections**

**Lower fuel acquisition time
(fuel diversification)**





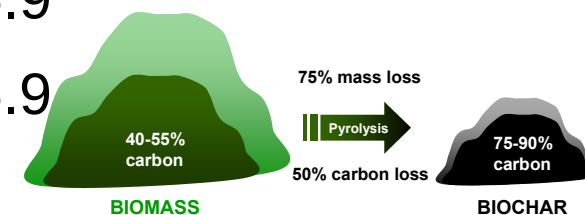
Balance



2 t/hr with
electricity
generation

Energy balance (MJ/MJ), Slow pyrolysis

	Biochar to energy	Biochar to soil
Switchgrass	7.0	5.3
Forage corn	3.0	2.3
Corn stover (crop residue)	9.1	6.9
Wheat straw	9.0	6.9





Balance

Avoided Emissions (kg CO₂/ha/yr), Slow pyrolysis

	Biochar to energy	Biochar to soil
Bioenergy crops	4083-7710	12,551-18,595
Crop residues	2002-3736	9575-11,833



Balance

Cost of avoided emission (US\$/ton), Slow pyrolysis

	Cost of CO ₂	Cost of Biochar
Bioenergy crops	14-16	47
Crop residues	9-10	46-47



Biochar Proof of Concept

- ☐ Atmospheric CO₂ can be sequestered as biochar in soils for long periods of time
 - ☐ It does not pose a storage risk but an opportunity to improve natural resources and support sustainability
 - ☐ It can (but does not have to be) combined with energy generation
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